JOINT HIGHWAY
RESEARCH PROJECT

ENGINEERING SOILS MAP OF SPENCER COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

December 12, 1978

File: 1-5-2-61

FROM: P. T. Yeh, Research Engineer
Joint Highway Research Project

Project: C-36-51B

The attached report, entitled "Engineering Soils Map of Spencer County, Indiana", completes a portion of the project concerned with development of a county engineering soils map of the State of Indiana. This is the sixty-first report of the series. The report was prepared by Dr. P. T. Yeh, Research Engineer, Joint Highway Research Project.

The soils mapping of Spencer County was done primarily by airphoto interpretation. Some test data along Interstate 64 and SR 45 are included in the report. Generalized soil profiles of the major soil from each land form are presented on the engineering soils map. An ozalid print of the Engineering Soils Map of Spencer County is included in the report.

Respectfully submitted,

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Final Report

ENGINEERING SOILS MAP OF SPENCER COUNTY, INDIANA

by

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Project No.: C-36-51B

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Prepared as Part of an Investigation

Conducted By

Joint Highway Research Project

Engineering Experiment Station

Purdue University

In Cooperation With

Indiana State Highway Commission

Purdue University

West Lafayette, Indiana

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The author wishes to acknowledge the assistance given by all those persons who have helped in the preparation of the report. Special acknowledgements are due the members of the Advisory Board, Joint Highway Research Project for their active interest in furthering the study and Professor R. D. Miles, in charge of the Airphoto Interpretation, Photogrammetry and Site Selection Laboratory for review and suggestions.

All 1940 airphotos used in connection with the preparation of this report automatically carried the following credit line: photographed for Commodity Stabilization Service, Performance and Aerial Photography Division, United States, Department of Agriculture.

ENGINEERING SOILS MAP

OF

SPENCER COUNTY, INDIANA

INTRODUCTION

The engineering soils map of Spencer County, Indiana which accompanies this report was done primarily by airphoto interpretation. The aerial photographs used in this study, having an approximate scale of 1:20000 were taken in July 1940 for the United States Department of Agriculture and were purchased from that agency. A recent set of photography with a scale of 1:24000 taken in October 1977 and furnished by the Indiana State Highway Commission were used to map the recent man-made features.

Aerial photographic interpretation of the land forms, parent materials and engineering soils of this county was accomplished in accordance with accepted principles of observation of inference (1)*. A field trip was made to the area for the purposes of resolving ambiguous details and correlating aerial photographic patterns with soil texture. Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were employed to delineate land forms and soil textures. The text of this report largely represents an effort to overcome the limitation imposed by adherence to a standard symbolism and map presentation

No soil samples were collected and tested by the staff of the Joint Highway Research Project but general soil profiles were developed and are shown on the soils map. The soil profiles were compiled from the agricultureal literature and from the boring data of the roadway

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*Number in parentheses indicate reference in the bibliography.

soil survey along I-64 and SR 45 supplied by the Indiana State Highway Commission. Liberal reference was made to the "Fromation Distribution and Engineering Characteristic of Soils" (2), and to the "Soil Survey of Spencer County, Indiana" (3).

DESCRIPTION OF THE AREA

General

Spencer County is located in the south-central part of Indiana. Rockport, the county seat, is located along the Ohio River about 30 miles (48.3 km) southeast of Evansville. The county is irregular in shape because the boundaries follow the courses of the Anderson River in the east, the Ohio River to the south and Little Pigeon Creek on the west. The county is bounded on the east by Perry County on the north by Dubois County on the west by Warrick County and on the south by Daviess and Hancock Counties of Kentucky (Figure 1). Spencer County has an area of 396 square miles or 253,440 acres (1026 sq. km.) (4). According to the 1974 Census of Agriculture about 76.5% of Spencer County or 193,055 acres (782 sq. km.) was farm land and about 10.9% of the county or 27,574 acres (111 sq. km.) was wood land (4). The wood lands were generally confined to the sandstone and shale region and along the steep bluffs of gullies of rivers and streams as shown in Figure 2. Spencer County had a population of 17,134 in 1970 and 2,565 resided in Rockport as reported by the Census (5).

Drainage Features

Most of Spencer County lies within the Minor Ohio drainage basin. Only a small area in the north central part is in the Patoka drainage basin. The eastern part of the county is drained by the Anderson River.

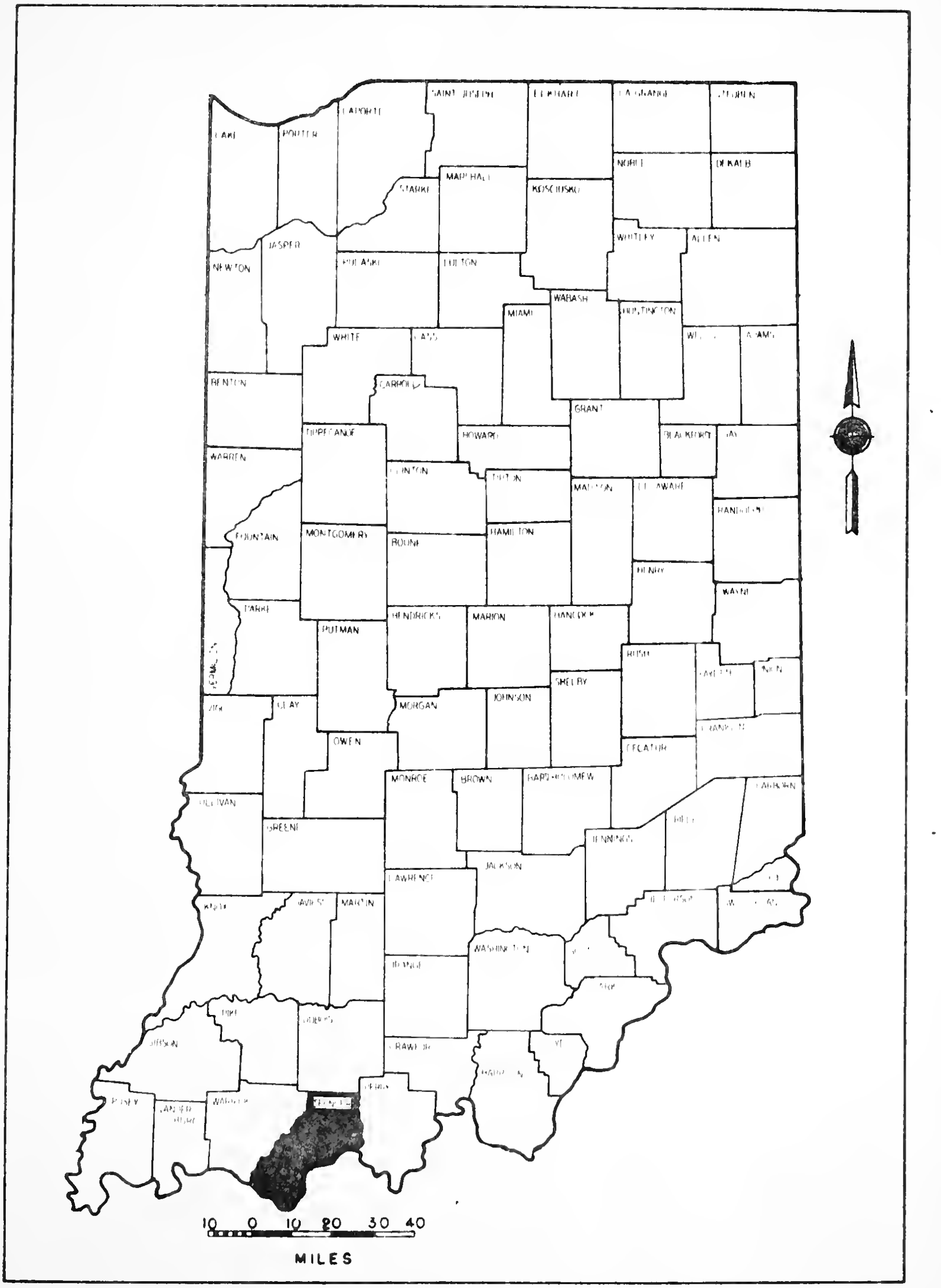

FIG. I LOCATION MAP OF SPENCER COUNTY

FIG 2. AIRPHOTO MOSAIC OF SPENCER COUNTY, INDIANA

FROM 1940 INDEX MAP

The waters of the central portion of the county are carried by southerly flowing Crooked Creek, Sandy Creek and Honey Creek. The western part of Spencer County is drained by Little Pigeon Creek. Streams flowing on the south western portion of the county, such as Caney Creek, Garrett Creek and Willow Pond Creek are nearly parallel to the curve of the Ohio River.

Streams in the eastern part of the county meander through rocky valleys. The tortuous courses along Anderson River and Crooked Creek can be clearly observed on the drainage map shown in Figure 3. A slackwater channel extends northwest from near Rockport to the Little Pigeon Creek Valley on the western boundary of the county as shown in Figure 3.

Dense natural drainage systems are well developed in the upland areas. Many ditches have been constructed to improve sluggish drainage conditions especially in the southwestern part of the county. Stream channels have been widened, straightened and deepened in some cases. Many natural drainage channels have been changed because of extensive strip mining operations within the county.

There are no natural lakes in Spencer County. However, ponds and lakes of various origins are scattered over the area. The biggest lake is located near Santa Claus.

Climate

The climate of Spencer County is continental, humid and temperate. The warm humid summers and moderately cold winters are characterized by frequent sudden changes of temperature. Since no long climatological data is recorded in this county, the data recorded in Tell City of Perry County and Evansville of Vanerburg may be used as reference for Spencer County.

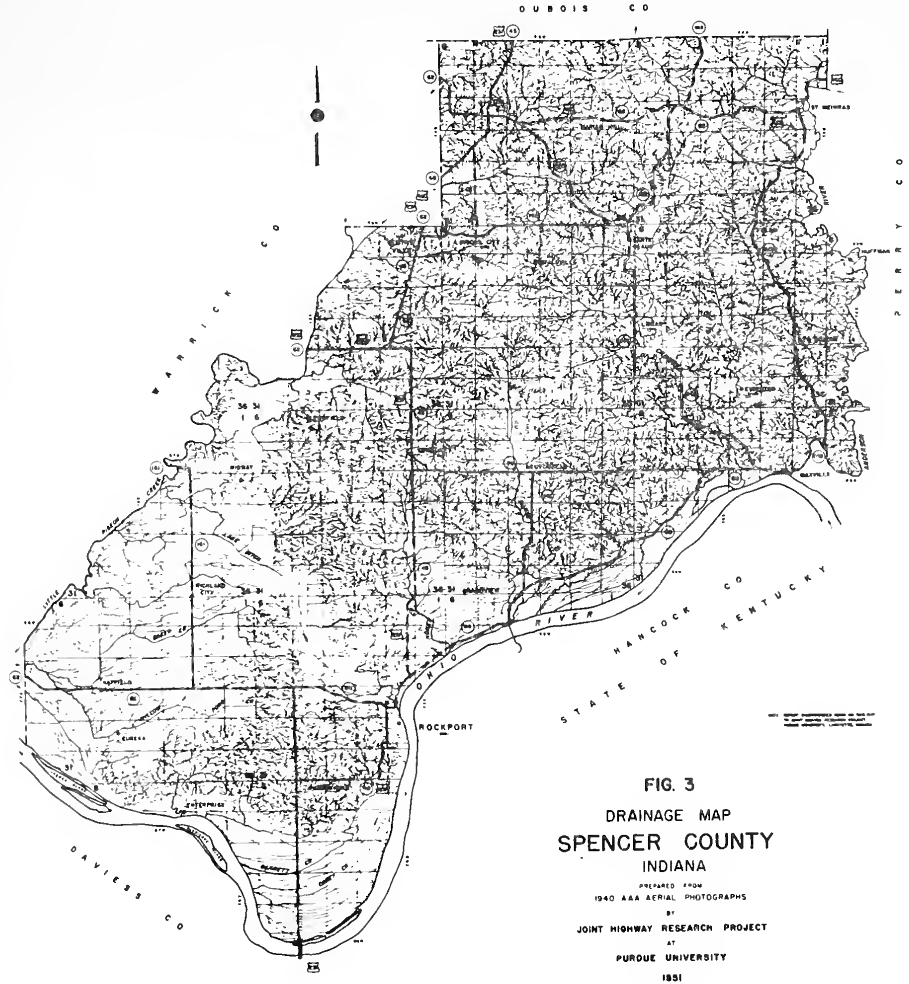

FIG. 3

DRAINAGE MAP

SPENCER COUNTY

INDIANA

PREPARED FROM

1940 AAA AERIAL PHOTOGRAPHS

BY

JOINT HIGHWAY RESEARCH PROJECT

AT

PURDUE UNIVERSITY

1951

The mean and extreme temperature and precipitation of Evansville is listed in Table 1 (6) and that for Tell City is listed in Table 2.

Physiography

Spencer County lies wholly in the Wabash Lowland province of the state (Figure 4). With respect to the physiographical situation in the United States, the county lies wholly in the Aggraded Valley section of the Interior Low Plateau province (7).

The Wabash Lowland in Spencer County is characterized by intensive areas of alluvial and lacustrine deposits surrounding bedrock hills. The evidence of filled in or aggraded valleys is readily observed on the aerial photographs.

Topography

The topography of Spencer County is of great variety. The most outstanding feature is the dissected upland in the eastern part of the county. This north-south uneven hills and ridges are the results of the severe erosion of a peneplain. Knobs with an altitutde greater than 650 feet (198 m) above sea level are scattered along these ridges (Figure 5). The highest elevation of Spencer County is about 680 feet (207 m) above seal level located at the NE corner of Sec. 3, T.6S, R.4W. The maximum local relief of the county reaches 240 feet (75 m) and occurs just north of the high knob mentioned previously. Local reliefs from 100 to 150 feet (30 to 45 m) are quite common in this highly dissected region. West of the ridge region, the surface of Spencer County is slopping downward from the northeast toward the southwest. A rolling topography is predominant in this region. The rolling upland varies considerably in elevation but rarely exceeds

Table 1. Normal and Extreme Monthly Temperatures and Precipitation of Evansville, Vanderburgh County, Indiana

	Temperature			Precipitation			
Month	Mean °F	Absolute Maximum °F	Absolute Minimum	Mean Inches	Driest Year (1930)	Wettest Year (1882)	Average Snowfall
January	32.6	76	-21	3.40	6.20	5.95	3.5
February	35.9	79	-23	3.27	3.12	14.62	3.5
March	44.3	87	- 9	4.69	19.7	4.72	2.9
April	56.7	92	24	4.06	1.10	4.17	.4
May	65.7	98	28	4.38	1.02	8.45	0
June	74.7	106	41	3.57	2.28	5.25	0
July	77.8	109	47	3.77	1.23	6.05	0
August	76.2	105	46	2.95	1.29	6.70	0
September	69.1	107	31	2.80	3.39	3.30	0
October	58.2	97	21	2.52	1.31	2.25	T
November	44.9	83	- 3	3.17	1.00	3.65	.8
December	35.3	75	-10	3.30	1.69	5.50	2.2
Year	56.0	109	-23	41.88	25.60	70.61	13.3

Table 2. Mean and Extreme Monthly Temperature and Precipitation of Tell City, Perry County, Indiana. Means and Extremes for Period 1951-1974.

	Temperature			Precipitation		
Month	Mean °F	Record Highest °F	Record Lowest °F	Mean Inches	Greatest Monthly Inches	Greatest Daily Inches
January	32.8	74	-13	3.50	6.79	2.40
February	35.7	77	- 8	3.32	8.08	2.19
March	43.7	80	1	3.74	16.17	4.05
April	55.9	88	20	4.56	14.12	6.05
May	65.2	95	30	4.73	9.33	3.75
June	73.9	102	42	4.22	7.37	3.47
July	77.8	105	47	3.78	9.16	2.65
August	76.3	104	47	3.38	11.50	2.94
September	69.9	106	36	3.05	6.83	3.60
October	58.5	96	21	2.31	6.87	2.65
November	46.0	82	10	3.75	10.04	3.62
December	36.6	72	- 3	3.64	7.29	2.31
Year	56.0	106	-13	45.00	16.17	6.05

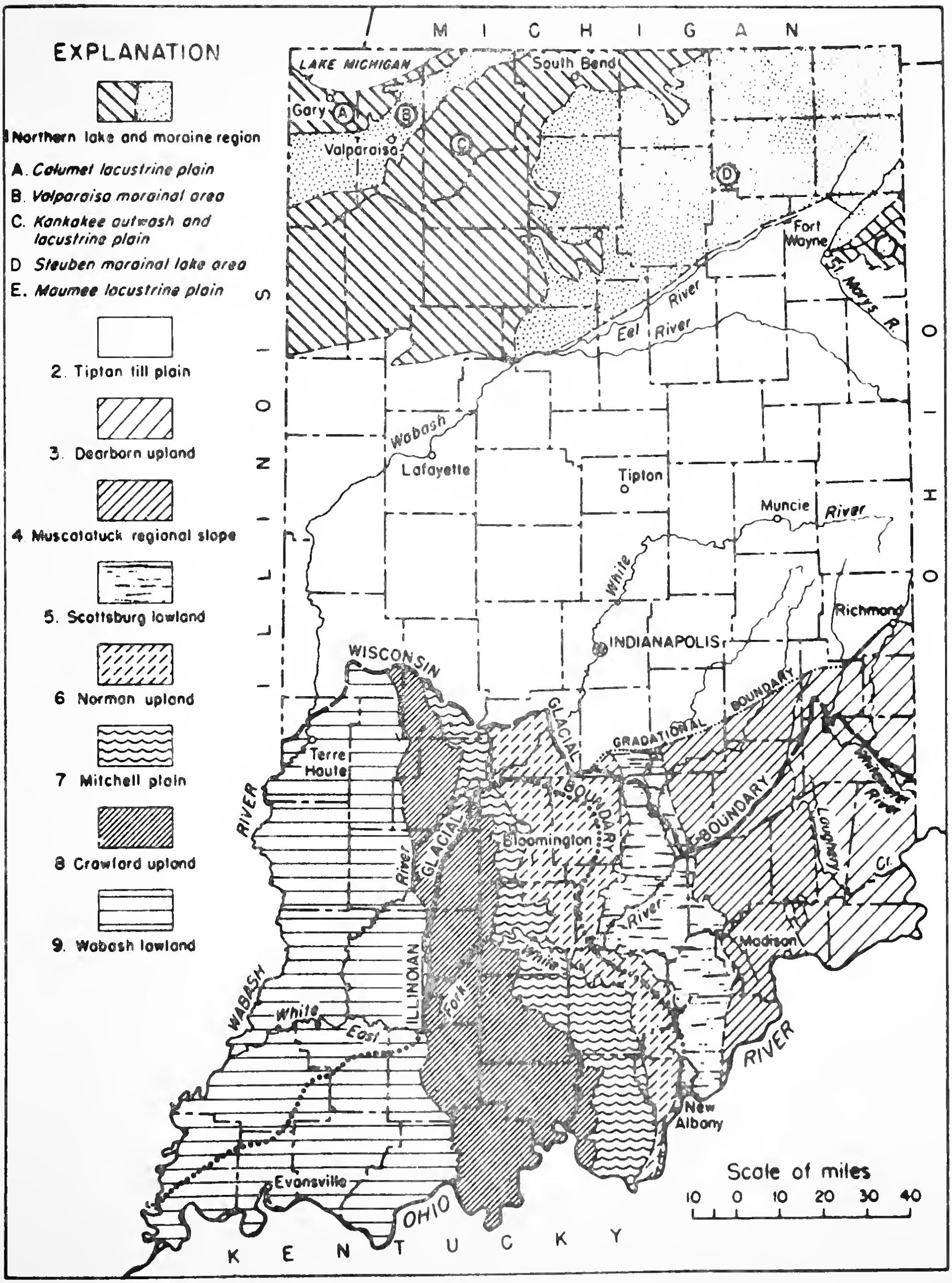

Figure 4 Map of Indiana showing regional physiographic units based on present topography. Modified from Malott

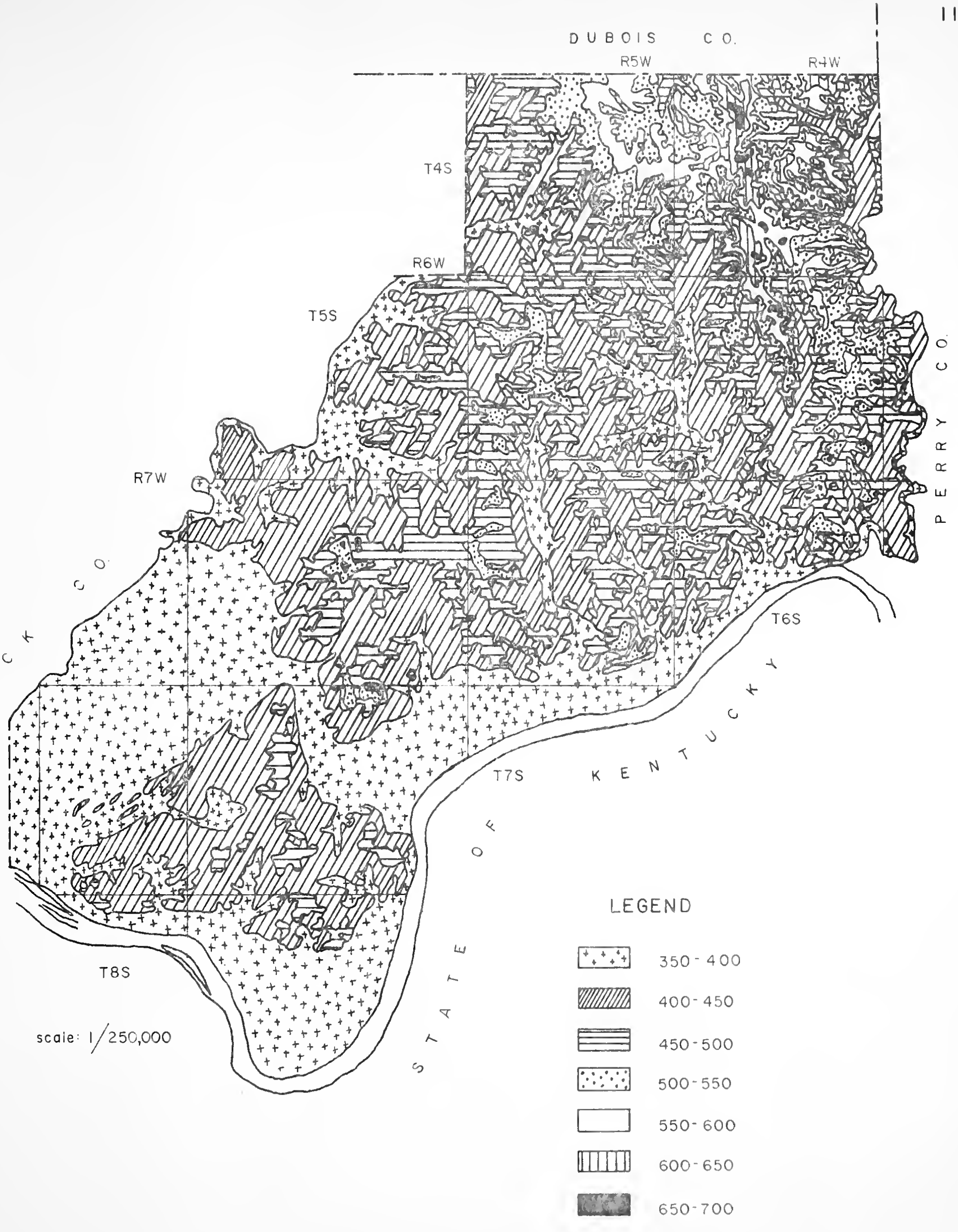

FIG. 5 TOPOGRAPHIC MAP OF SPENCER COUNTY

500 feet (152 m) above seal level. A few ridges and hills of various heights are found in this region. Fisher Knobs located in Sections 9, 16 and 17, T.6S, R6W reaches an elevation of 630 feet (192 m) and is the most prominent knob of the region. Coal Knobs located about three miles (4.8 km) south of Fisher Knobs is another outstanding knob. The highest point of Coal Knob reaches 600 feet (183 m) above sea level. Both Knobs are nearly 200 feet (61 m) above the surrounding land. Only a few hills in this region have very steep slopes. The majority of the hills, however, are characterized by their smooth, gently rounded forms with intervening shallow and broad valleys. Steep, precipitous bluffs 75 to 100 feet (23 to 30 m) in height occur along the Ohio River.

A huge flat bottom land occurs in the southern third of Spencer County. This region is composed of the flood plain and the terrace of the Ohio River. The difference of elevations between these two plains varies from place to place but rarely exceeds 15 feet (4.5 m). The altitude of the flood plain along the Ohio River varies from 385 feet (118 m) at the southeast corner to 370 feet (113 m) at the southwest corner. Curvelinear current markings is the characteristic feature in this region. Along the major drainage channels in Spencer County the valleys are flat and wide. Most of the valleys received a lacustrine or slackwater deposit during the Wisconsinan and the Illinoian glaciation period (8). The altitude of the lacustrine plains within the county are quite uniform. It varies from 400 to 410 feet (122 to 125 m) above sea level.

A few narrow sand and silt ridges may be observed at the southwestern corner of the County. These are wind deposits (Figure 5). The ridge varies from 400 to 450 feet (122 to 137 m) in elevation above sea level.

A number of them rise only a few feet above the surrounding flat lacustrine plain.

Scattered along the central part of the county are a special made feature that may be recognized. This is the result of strip mining of coals in the county

The lowest elevation in Spencer County is about 350 feet (106 m) above sea level along the Ohio River at the border with Warrick County on the west.

Geology

The surface and near surface geologic ages represented in Spencer County are the Quaternary period and the bedrock of Palezoic age. The Quaternary materials are both pleistocene and recent in age.

The general surface deposits of the County are shown in Figure 6. The areas along the Ohio River, Little Pigeon Creek, Anderson River and Crooked Creek are classified as clastic sediments of silt, sand and gravel of the Martinsville Formation by Wayne (9).

The area immediately to the north in the southern third of the county is classified as valley train deposits, outwash facies of the Atherton Formation (9). The material in this deposit is mainly gravel, sand and silt.

Almost all the wide drainage valleys in Spencer County are covered by lacustrine deposits. This clay, silt and sand deposits are classified as the Lacustrine facies of Atherton Formation (9).

The upland areas in the southern two thirds of the county are wind blown silt and sand deposits. It is classified as the loess facies of the Atherton Formation (9). A narrow belt in the southwestern quarter

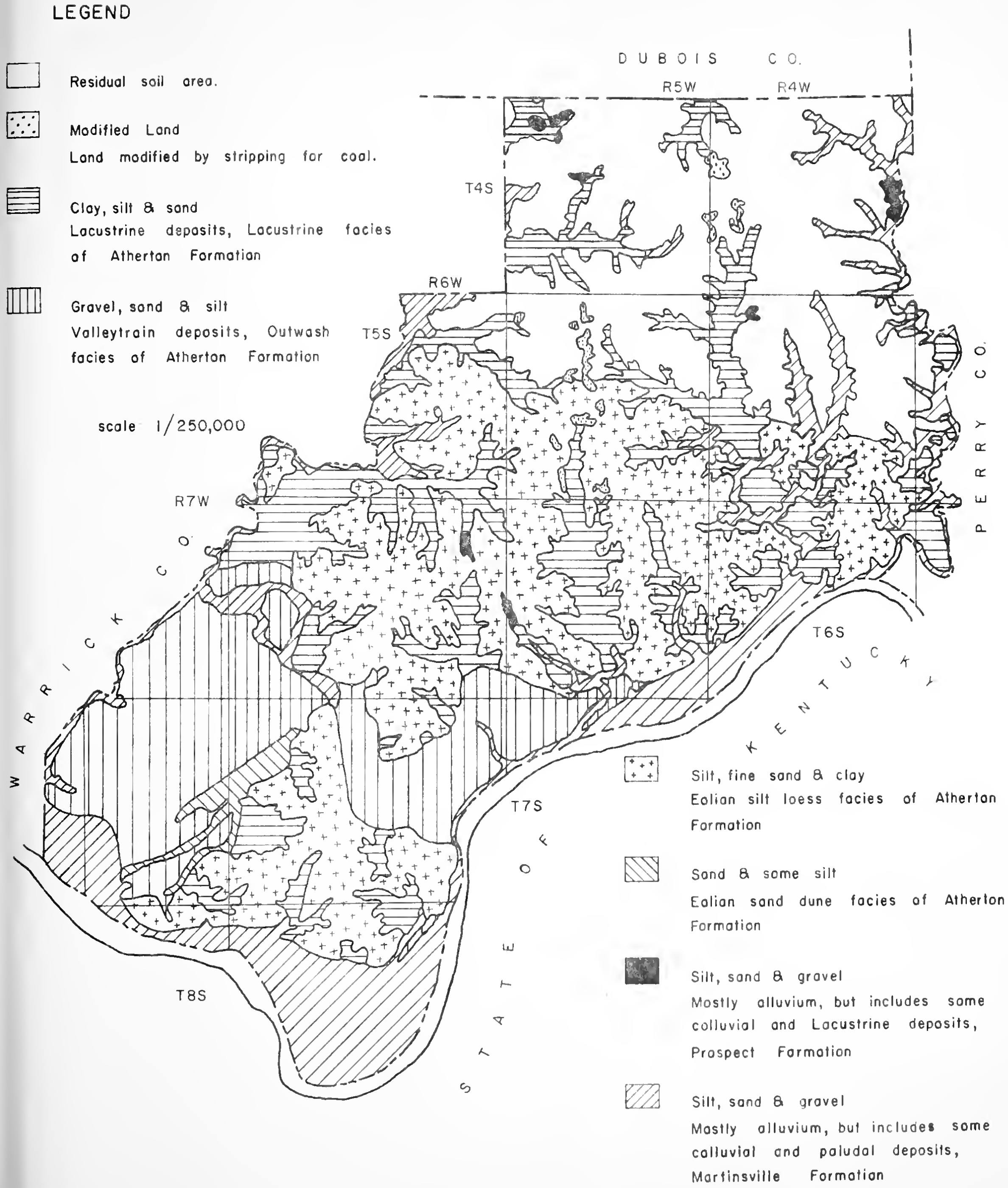

FIG. 6 UNCONSOLIDATED DEPOSITS IN SPENCER COUNTY

of the county is recognized as dune facies of the Atherton Formation. The deposits are mainly fine sand with limited amounts of silt.

The northern third of the county is a residual soil area. The bedrocks underneath the residual soil and the unconsolidated surface materials are rocks of the Pennsylvanian period. The majority of the county is on the interbedded shale and sandstone formation of the Raccoon Creek Group. However, a few isolated areas in the southwestern part of the county belong to the interbedded shale and sandstone of the Carbondale Group.(Figure 7). Some limestone, clay and coal layers are found in the strata as illustrated in Figure 8. The outline of the top of the Buffaloville coal member is shown in Figure 7 also.

LAND FORM AND ENGINEERING SOIL AREAS

The engineering soils in Spencer County are derived both from the unconsolidated material and from the weathering of sandstone and shale bedrocks (see Figure 6). The residual soils are confined mainly in the northeastern half of the county. The unconsolidated materials include fluvial deposits and eolian deposits.

The entire county essentially is covered by loess deposits of various depths as indicated in Figure 9 and Appendix A (10). The deepest deposit occurs at the southwestern corner of the county and the depth decreases toward the northeastern corner. The depths of loess were measured on the flat areas where erosion of the deposit is at a minimum. The engineering soil areas within this region are subdivided according to the depth of the loess and its erosional conditions.

The deposits of transported materials are not homogeneous and variation should be expected. The general properties and profile of the soils for each area of different land form, are presented on the map that accompanies this report.

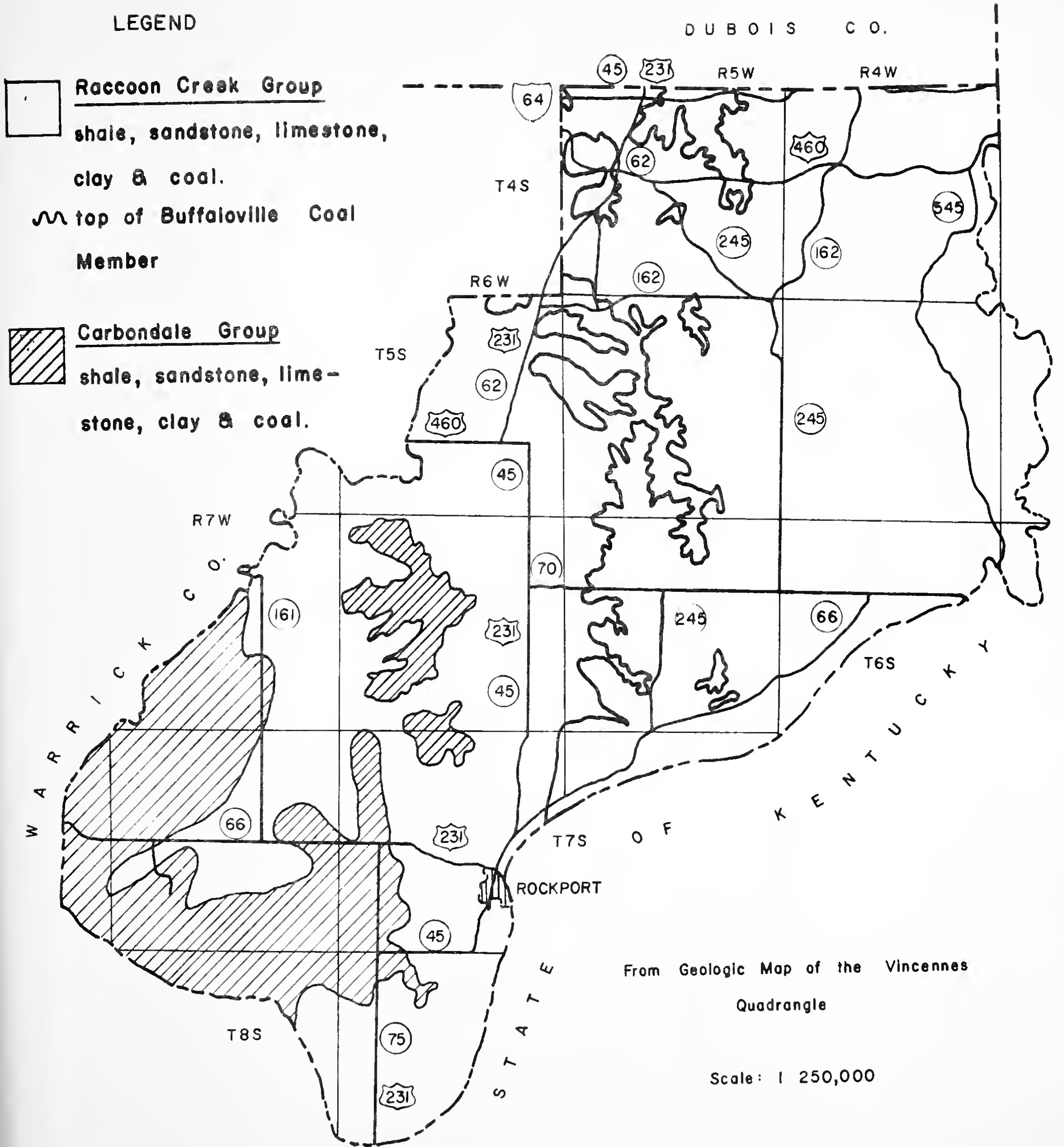

FIG. 7 BEDROCK OF SPENCER COUNTY

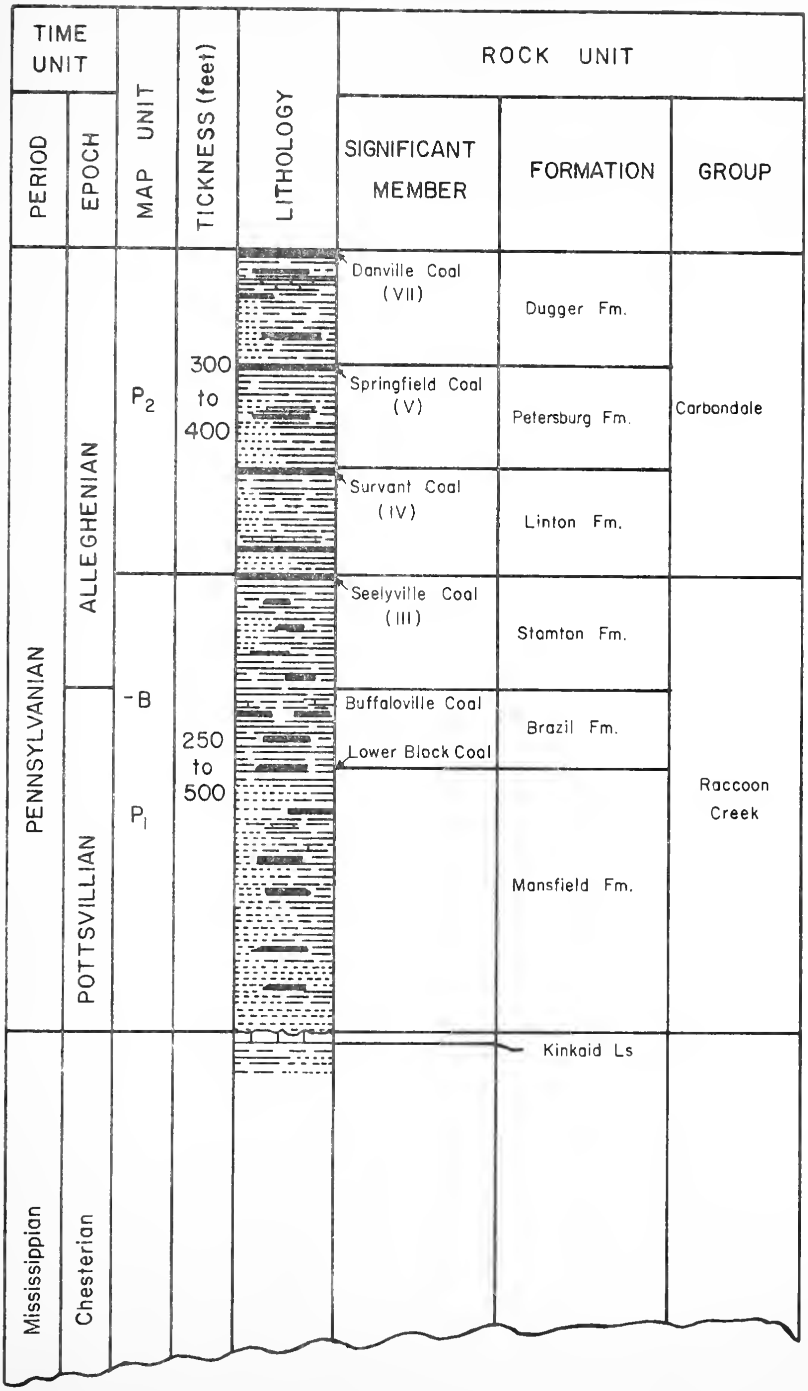

FIG. 8 COLUMNAR SECTION SHOWING BEDROCK UNITS

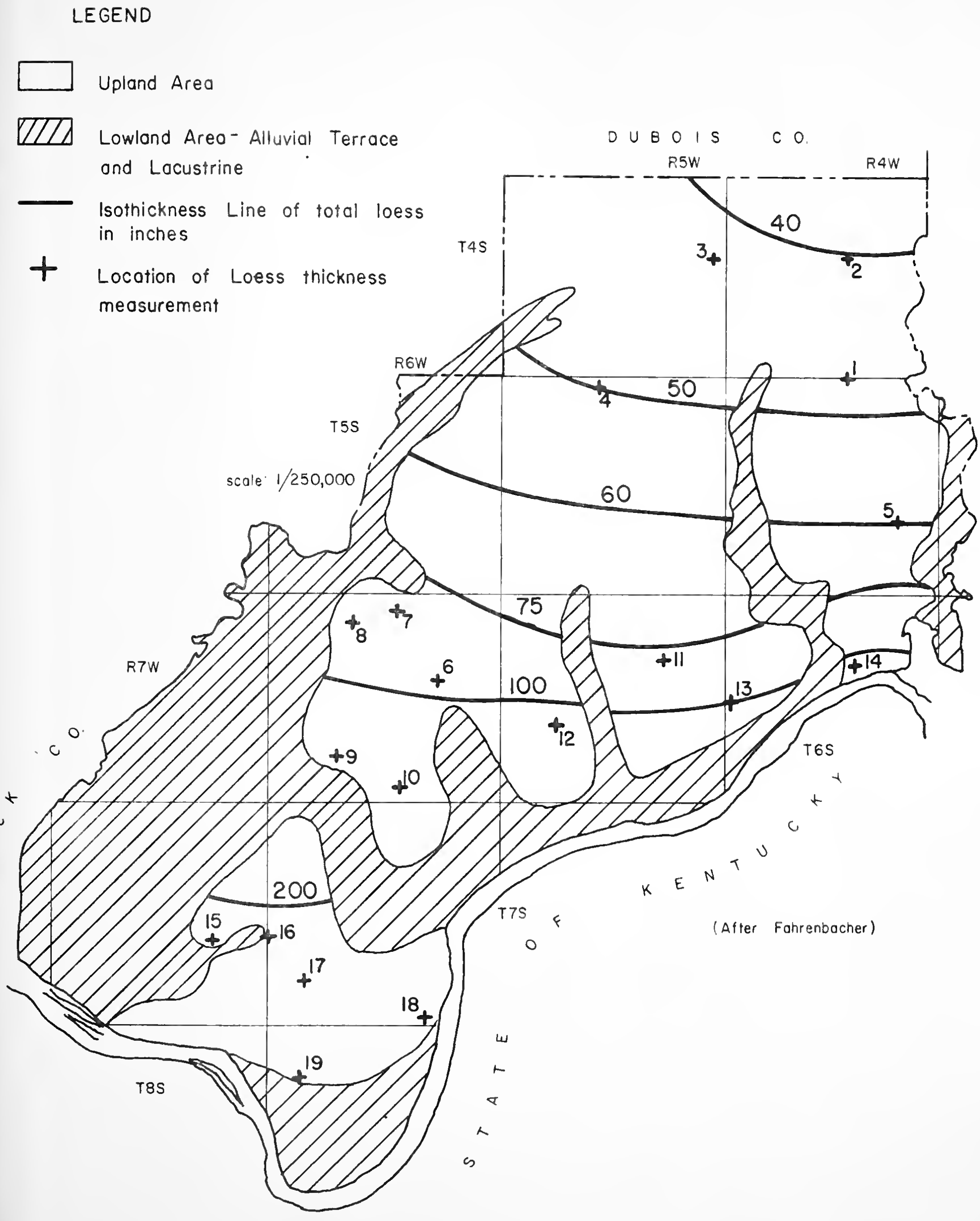

FIG. 9 ISOPACHOUS MAP OF LOESS DEPOSIT IN SPENCER COUNTY.

Eolian Deposted Materials

There are extensive eolian (wind) deposits in Spencer County. The eolian deposit is subdivided into two groups: sand deposits and loess deposits.

1. Windblown Sand Deposits

Windblown sand deposits are very limited in Spencer County. They occur mainly on the Ohio River terrace and along the bluff of the adjacent uplands. A group of elongated low dunes can be recognized easily from the airphoto near the southwestern corner of the county.

The dunes on the terrace are low dunes. They are only a few feet (1 to 2 m) and seldom over ten feet (3 m) above the surrounding terrace. The dunes along the edge of the upland are much higher (up to 50 feet) (15 m) above the adjacent ground) in elevation and in a nearly straight ridge form.

Surface drainage is absent in the sand dune or sand ridge areas. However, infiltration basins are visible in the low dunes located on the Ohio River terrace.

Although the materials of the sand dunes are predominantly fine uniform windblown sand, a considerable amount of silt and clay particles are mixed with the sand. The texture of the dunes is finer on the eastern side. At places along the sand ridge layers of silt can be seen on the cut face. A good exposure occurred in a pit located just east of SR 161 about 800 feet (240 m) north of SR 66.

The soil profile of the sand dune deposit consists of a fine sandy loan top soil (A-4), a sandy clay loam to loam (A-6) subsurface soil. A silty clay loam (A-6) usually follows the loam subsurface soil and a fine sandy loam (A-4) soil appears further down before the

fine sand (A-3) parent deposit is reached. On the lower dunes on the terrace material of stratified sand silt and fine gravel may be encountered below a depth of three to nine feet (1 to 3 m).

Since the sand dune deposits in Spencer County vary widely in texture, engineers should be aware of the different characteristics of the silty and sandy soils and design accordingly.

2. Windblown Silt Deposits

All of the uplands in Spencer County are covered by windblown silts or loess. The loess deposits are subdivided into groups according to the depth of the loess and the type of underlying materials. The subdivisions are: (a) Moderately deep loess deposit, (b) Loess covered lacustrine deposit, (c) Loess covered sandstone-shale, (d) Sandstone-shale with a loess veneer.

(a) Moderately Deep Loess Deposits

About one sixth of Spencer County is considered as moderately deep (above six feet and up to 15 feet or 2 m to 5 m) loess deposit. The loess deposits are thicker (about 15 feet or 5 m) at the southwestern corner of the county as illustrated in Figure 9 and Appendix A.

The thick loess deposits occur on all the ridge tops where erosion is at a minimum. The depth of the loess decreases rapidly toward the stream and gullies.

The loess deposits in Indiana have been mapped previously by Moultrop on a regional basis (11). Some minor changes or refinements have been made for this county engineering soils map.

In the region near the center of the county where the loess is thining toward the northeast, the moderately deep loess deposits are confined along the narrow ridge tops. The elevation of the ridge tops

vary only slightly in many places. In the southwestern portion where the loess deposit is thicker, the topography varies from undulating to gently rolling.

A few narrow silt ridges are found on the upland borderning the Ohio River terrace to the west. These ridges are closely associated with the sand dunes to the west mentioned previously. The only difference is the size of the grains. In places the deposit is a coarse silt approaching to a very fine sand. The surfaces of the ridges are much smoother than the sand dune to the west. The height of the ridge is also reduced to considerably less than the sand dune mentioned.

Surface drainage ways are well developed along the major streams. The typical pinnate drainage pattern for deep loess deposits occur only occasionally.

The soil profile of the moderately deep loess deposit has a silt loam or silty clay loam (A-4 or A-6) soil in the A-horizon. The B-horizon is a more plastic silty clay loam to silty clay soil (A-6 to A-7-6). The C-horizon ranges from silt loam to silty clay loam (A-4 to A-6) soil. The interbedded sandstone and shale bedrock generally occurs more than eight feet (2.5 m) below the surface.

A soil sample, taken at a place about 2 miles (3.2 km) southeast of Midway by Moultrop, where the thickness of the loess is 54 inches (1.37 m) over sandstone-shale shows that the composition of loess consists of 13% sand 67% silt and 20% clay. The liquie limit and plastic index are 34 and 12 repectively (11).

The engineering problem in this area is primarily the control of moisture during the construction and compaction of the silty material. The subgrade will become weak under adverse moisture or due to frost action in winter. Pumping is a problem.

(b) Loess Covered Lacustrine Plain

About three square miles (7.8 sq. km) of area near the southwestern part of Spencer County and a few smaller scattered areas along the Ohio River near the southeastern corner of the county are recognized as loess covered lacustrine plains. The deposits have a gently undulating topography in the west to a flat topography in the east. The light and dark photo tonality indicated the high and low topographic positions in the western deposit are very pronounced. The eastern deposits have a more uniform tonality. The altitutde of the deposit in the west varies between 403 to 414 feet (123 to 126 m) above sea level. Although the altitude difference between the terrace (about 390 feet or 119 m above sea level) to the west and the lacustrine plain (about 400 feet or 122 m) to the east is not great the topographic breaks between them are clearly defined from the airphotos. A few isolated low ridges or mounds of loess can also be found in the lacustrine plain nearby.

The characteristics of the lacustrine plain is obliterated entirely by the loess blanket. Surface drainages are poorly developed. Infiltration basins or occassionally a phantom drainage pattern appears in the area of the western part of the county.

The soil profile is essentially the same as that of the moderately deep loess deposit. The topsoil varies from a silt loam (A-4) in high positions to a silty clay (A-6) with considerable amount of organic material in the low depressions. The B-horizon is more clayey in texture which ranges from silty clay loam to silty clay (A-4 to A-6 and A-7-6 at lower area). The C-horizon is composed of silty clay loam to silty clay (A-4 to A-6) soil. The underlying lacustrine deposit varies from silty clay to clay (A-6 to A-7-6).

Special problems associated with this soil are essentially the same as those in the moderately deep loess region. However, if deep cuts are required the problem of weak support of the lacustrine deposits should be taken into account.

(c) Loess Covered Sandstone-Shale

About one-third of Spencer County is recongized as loess covered sandstone-shale area. The deposit is confined mainly in the northeastern half of the county. This region is dissected by stream and gullies. The topography varies from gently rolling to hilly, sloping steeply toward the adjacent valley. Local relief in the order of 100 to 150 feet (30 to 45 m) is quite common in this region. The influence of bedrock can be realized from the angular courses of the streams in this area, especially along Anderson River and Crooked Creek (see Figure 3).

Since the sandstone-shale bedrocks are covered by a blanket of loess with a thickness which varies from 13 to 60 inches (45 cm to 1.5m) the upper soil profile is derived from the loess material. The top soil is either a silt loam (A-4) or silty clay loam (A-6) soil. The subsurface soil is predominately silty clay loam (A-4 to A-6) soil. The weathered sandstone-shale residual soil may be found as sandy loam, silt loam or clay loam or clay under the loess deposits. The boring along I-64 listed in Appendix B represents this region. The near surface soil taken at a depth of 1 to 2 feet (25 cm to 50 cm) at site #1 is a silty clay loam (A-4 (8)) soil. At sites Nos. 16 and 17 taken from 0.5 to 2.0 feet (12 cm to 50 cm) the soil is classified as silty clay (A-6 (8)) and (A-7-6 (11)) respectively. Most of the subsoils are clay (A-6 to A-7-6) soil derived from the weathering shale. Shale

fragments are present in many sites. The only sandstone residual soil sample was found at site no. 19 at a depth of 10.0 to 10.5 feet (3.05 to 3.20 m) below the surface. The residual soil consits of 9% gravel 53% sand 18% silt and 20% clay and is classified as sandy clay loam A-4 (3) soil.

For a more detail boring profile the reader may refer to the soil profile survey (12). Sandstone, coal and shale are found at various depths along I-64 in this region.

Boring sites along SR 45 north of Chrisney indicated that the subsurface soil taken at site nos. 20 and 21 (see Appendix C) at depths of 1.0 to 2.5 feet (37 to 77 cm) and 2.0 to 5.0 feet (0.6 to 1.5 m) respectively are silty clay (A-6) soil. Further down the profile at a depth from 5.5 to 8.0 feet (1.5 to 2.4 m) the soil remains as a hard silty clay but classified as A-4 (8) by the AASHTO classification. At a depth of 8.0 feet (2.4 m) from the surface at both sites the hard clay classified as A-7-6 soil is a weathered shale. The weathered shale became a little plastic and classified as clay (A-6) soil at a depth about 17 to 18 feet (5.2-5.5 m) below the surface (13). Hard weathered sandstone is found at site no. 20 at a depth 22 feet (6.7 m) below the ground surface (13).

Engineering problems in this soil region are generally associated with the different characteristics of the underlying residual bedrock soils and the bedrock materials. A shallow cut and fill may encounter several different materials in a short distance.

(d) <u>Sandstone-Shale With Loess Veneer</u>.

Sandstone-shale with loess veneer soil is scattered in the loess covered sandstone-shale region just mentioned. Two islands like hills are located north of Rockport. This soil is confined to the valley

wall areas and the slopes of the ridges or hills where erosion has removed not only most of the loess deposit but some of the residual soil of the sandstone-shale also. The topography of this region is extremely rugged and blocky. Gullies are carved into the sandstone-shale bedrock at their upper reaches. Gullies are numerous and closely spaced. A white fringe which reflects the lack of soil on rock of the area can be seen on the aerial photographs.

The area usually has 18 to 25% slopes. Steeper slopes may occur along the gully land. The land is suitable only for forest. Therefore from the vegetation of land use pattern alone the areas are easily delineated.

The soil profile varies greatly depending on its topographic position, erosional situation and the rock types. On a normal soil profile the topsoil varies from a sandy loam to silty clay loam (A-4). It is underlain by silt loam or silty clay (A-4 to A-6) soils with a considerable amount of stone fragements before the interbedded sandstone and shale bedrock is reached. The bedrock generally can be found at a depth from 15 to 42 inches (38 cm to 107 cm) from the surface. However, in places, where the erosion is severe, the top layer may be removed and the underlying bedrock exposed. This may be considered as non-soil area.

Thick, massive Mansfield sandstone is exposed at Rockport along the Ohio River bank and along SR 66 about two miles (3.2 km) northeast of Grandview. Numerous exposures of sandstone slabs can be seen in highway cuts in this area.

The engineering problems associated with this region are associated with the cuts and fills. Different types and characteristics of resi-

dual soils or bedrock may be encountered within short distances both horizonally and vertically.

Fluvial Deposited Materials

About half of Spencer County is covered by fluvial deposited materials. Three different land forms created by the action of water namely, lacustrine plain, terrace and alluvial plain are discussed as follows.

1. Lacustrine Plain

About one quarter of the fluvial deposited materials in Spencer County are classified as lacustrine deposit or slack water deposits. These lacustrine plains were formed in the lower valley of the tributaries along the Ohio River during the Wisconsinan glaciation period (14). Huge lacustrine plains are found along the Little Pigeon Creek, Crooked Creek and Anderson River. Smaller ones are scattered in the smaller tributaries

The altitude of the lacustrine plain in Spencer County varies between 400 feet to 420 feet (122 m to 128 m) above sea level. The surface is flat and devoid of natural surface drainage development in the huge lacustrine plains. Ditches were dredged in these areas to facilitate the drainage. In the smaller lacustrine plains numerous steep gullies were carved along the edge of the plains and the stream valleys deeply below. The generally flat lacustrine plain became a dissected plain in these areas.

The uniform dark tone of the huge lacustrine plain is broken occasionally by scattered small light tonal mounds which indicates a better drainage position of the slightly higher thin loess deposits. Since the mounds are small and the loess mantle is thin no seperation is made on the engineering soils map.

The edge of the laustrine plain abutting with the upland usually contains sheet wash deposits from the surrounding uplands. A coarse textured material is usually found toward the upland. At the upper reach of the stream valley some of the areas included in the lacustrine plain may be considered as alluvial deposits. The delineation between the two is difficult in many places because the different of elevation between the two is approaching zero.

The lacustrine plains are covered by a loess veneer from 6 to 40 inches (15 to 100 cm) in depth. The soil is developed partly from the thin loess cover and partly from the sheet wash materials from the uplands. The topsoil varies from a silt loam to a silty clay loam (A-4) in the high position. The B-horizon ranges from a silty clay loam to clay (A-6 to A-7). Stratified silt, clay and fine sand are found beneath the subsoil. At the slightly low areas the topsoil may contain some organic matter and has a silty clay to clayey (A-6) texture. The B-horizon is silty clay to clay (A-7) without organic matter. Stratified clay and silty clay is found as parent material.

The engineering problems associated with the lacustrine or slack water plain are high water table, low load carrying capacity and settlement for heavy structures.

2. Terrace Deposits

About one third of the fluvial deposits of Spencer County are classified as terrace deposits. The main part of the terrace deposits are located along the Ohio River. The rest (less than 10%) are scattered along the Ohio River tributaries. The characteristics of these two are quite different. Therefore they are subdivided into Ohio River terrace or high terrace and slack water terrace or low terrace.

(a) Ohio River Terrace

A large terrace along the Ohio River in the southwestern quarter of Spencer County is classified as the high terrace. The terrace is separated into two by an island-like upland between Rockport and Enterprise. It appears that the massive Mansfield Sandstone formation had channeled the glacial melt water along the Ohio River westerly just north of Rockport during the Wisconsinan period.

Current scars, swales and low ridges are numerous on this terrace. However, infiltration basins which are a common feature for coarse textured terrace deposits are absent.

The terrace has a flat to gently undulating surface. The altitude varies from 380 feet (116 m) near the southwestern corner of the county to 400 feet (122 m) east of Rockport. Dithces are extensively dredged in this terrace to improve the sluggish drainage. This also indicates the fine texture of this terrace deposit.

The texture of the terrace varies greatly from place to place. On the high position, the surface soil ranges from a sandy loam to a silt loam (A-4). The B-horizon varies from sandy clay loam to silty clay loam (A-6). The parent material generally consists of stratified sandy loam sand, silt loam and silt. On the low topographic position, the surface soil ranges from loam to silty clay loam (A-4 to A-6). The B-horizon is a silty clay or clay (A-7). Stratified silt loam, silty clay loam, loam, clay loam and sandy loam may be found in the parent material.

Settlement problems can be expected in this area. For heavy structures, the subsurface soil should be investigated thoroughly.

(b) Slack Water Terrace

A few scattered slack water terraces can be recognized in Spencer County. Most occur along the upper reach of the Little Pigeon Creek and its tributaries.

The slack water terraces are extremely flat and only slightly higher than the adjacent flood plain. The topographic break between the flood plain and this terrace deposit is inconspicuous. Infiltration basins and current scars are completely missing in these terraces. Surface drainage channels are absent or poorly developed.

The soils of the slack water terrace are developed from stratified silt loam, silty clay loam, loam, and fine sand. The surface soil is mixed with alluvium washed in from the upland.

The soil profile on this deposit consits of silt loam to silty clay loam (A-4) topsoil, a silty clay loam to silty clay (A-4 to A-6) subsurface soil, a somewhat less plastic subsoil (A-6) and the stratified silt loam, silty clay loam, loam and find sand may be found at depth in the profile.

The major problems associated with this area are the high water table instability of the silty soils and occasional overflow.

3. Alluvial Plains or Flood Plains

Nearly half of the fluvial deposits or about one quarter of Spencer County belongs to the alluvial plain or flood plain. The extent of mapping of these plains was determined by the scale of the engineering soils map.

Due to the different sources of the alluvial materials and the forms of their deposition the flood plains in this county are subdivided into Ohio River flood plains, the alluvial plains of the aggraded valleys in the sandstone-shale region and the alluvial plains in the loess region.

(a) The Ohio River Flood Plains

The major part of the Ohio River flood plain has a nearly flat surface except where broken by a series of low current scars. Surface drainage is channeled along the sloughs or scars created by the currents of the flood waters. The altitude of the flood plain varies from 370 feet to 385 feet (113 to 118 m) above sea level and is about 30 feet (9 m) above the water surface of the Ohio River.

The soil textures varies according to their topographic and geographic positions. Coarser textured deposits are found at the natural levee near the channel. A finer textured deposit usually occurs in the slough and near the upland.

The soil profile in the high position has a sandy loam to silty clay laom (A-4) soil. The subsurface soil is about the same texture. Stratified silt loam and silty clay loam are found further down in the profile.

At the low topographic position the surface soil varies from a silt loam to a clay (A-6 to A-7). The subsoil ranges from silty clay loam to clay (A-7). The stratified deposits further down are interbedded silty clay loam, silty clay and clay. Lenses of sand and gravel may be found at depth.

The major engineering problem in this area is associated with flood or high waters, the danger of scour and the weak supporting power of the unconsolidated deposits.

(b) Alluvial Plains of the Aggraded Valley in Sandstone-Shale Region

All the alluvial plains in the northeastern half of Spencer County are classified as alluvial plains of the aggraded valley in the sandstone-shale region. The deposits of the alluvial plains are derived from the

erosion of the surrounding loess covered sandstone and shale uplands. The highly erosive loess fills the valleys with silty deposits. The alluvial plain slopes gently from the upper reach toward the lower reach with a steeper gradient at the upper level. Some alluvial plains disappear or merge with the lacustrine plains downstream. Others cut narrow meandering paths through the large lacustrine plains. Channels are dredged and straightened in the wide flat alluvial plains to facilitate drainage of the valley.

Since the soil of the region is derived from the uplands, coarse textured materials may be expected adjacent to the foot of the upland and finer-textured materials further downstream.

The soil profile varies form a silt loam to a silty clay loam (A-4 to A-6) topsoil with a similar subsurface soil which is underlain by stratified silt loam, loam and sand with fragments of sandstone and shale deep down in the profile.

Boring site no. 12 is located in this region. However the alluvial plain in this particular area was the head water area of glacial Lake Patoka during the Illinoian glacial period (14) and was mapped as lacustrine deposit by Wayne (see Figure 6). It is likely that the bottom portion of the deposit is a lacustrine deposit and the upper layers are alluvial in origin. Soil boring profiles (12) show that the portion of the flood plain west of site no. 12 is a clay (A-7-6) soil varies in thickness from 7 to 30.5 feet (2.1 to 9.3 m) under the 6 inches (15 cm) of topsoil. The clay overlies shaly clay which appears to be weathered shale. The texture of the depoist changes at site no. 12. Silty clay loam (A-4) soil was reported under 6 inches (15 cm) of topsoil on the eastern portion of the flood plain - thickness

ranges from 2.5 to 13.5 feet (76 cm to 4.1 m). Sand loam (A-4) and clay (A-6 and A-7-5) were found in various layers further down the profile.

The boring report for site No. 12 showed the following. The first 9 feet (2.74 m) of soil is a silty clay loam (A-4). A 6-foot (1.83 m) layer of silty clay loam (A-6) follows and then 5 feet (1.52 m) of silty clay loam (A-4). A 4-foot (1.22 m) sandy loam (A-4) layer about 21 feet (6.4 m) of silty clay loam (A-4) occurs further down the profile before the weathered sandstone is reached at a depth of about 45 feet (13.7 m).

The engineering problems in this area are associated with high water and frequent flooding. Subgrade support is poor during the wet season. Settlement may become a problem for heavy structures.

(c) <u>Alluvial Plains in the Loess Region</u>

Alluvial plains in the loess region are confined to the southwestern part of Spencer County. The general features of the alluvial plains in this region and those in the sandstone-shale region are about the same except the valley is somewhat narrower in the loess region. The channels are also dredged and straightened to improve drainage. Since the deposit is derived from the surrounding loess upland silt is the predominant material of the soil.

The surface soil of this deposit is a silt loam (A-4). The subsoil is a somewhat plastic silt loam or silty clay loam (A-4 to A-6). The underlying material is a friable stratified silt loam and silt.

Runoff is slow in this region. The area is subjected to flooding in winter and early spring. Wetness and weak supporting power are the major problems in this area.

Miscellaneous

Strip Mines

Extensive coal mining operations can be observed from airphotos of Spencer County. The special jaw teeth pattern of strip mine spoil banks can be identified very easily. However, the recently reclaimed mines are rather difficult to detect after the surface has been leveled and planted with vegetation.

The strip mine operation generally is concentrated near the central part of the county in a north-south direction. It follows closely with the Buffaloville Coal Member as illustrated in Figure 7. Many of the mines have been located on the 1977 airphotos. Many new mines have been opened and expanded since the 1977 photography without the knowledge and time of investigation of the author. Therefore the areas marked on the engineering soils map can be considered accurate up to 1977 only.

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APPENDIX A

Loess thickness measurements in Spencer County by J. B. Fehrenbacher.

Site No.	Township	Range	Section		Total Depth in Inches	Underlying Material
1	4S	4W	34	SW 1/4, SE 1/4	45	SS soil
2	4S	4W	15	Center	40	SS soil
3	4S	5W	13	NE 1/4, SE 1/4	40	SS soil
4	5S	5W	4	NW 1/4, NW 1/4	50	SS soil
5	5S	4W	23	SE 1/4, SE 1/4	60	SS soil
6	6S	6W	14	NE 1/4, NE 1/4	80	Sh Residuum
7	6S	6W	3	SW 1/4, NE 1/4	70	SS Residuum
8	6S	6W	4	SW 1/4, SW 1/4	75	SS soil
9	6S	6W	29	SW 1/4, SE 1/4	110	SS soil
10	6S	6W	34	NW 1/4, NW 1/4	90	SS soil
11	6S	5W	20	NE 1/4, SW 1/4	95	SS soil
12	6S	5W	11	SE 1/4, SW 1/4	70	SS soil
13	6S	4W	18	SW 1/4, SW 1/4	75	SS soil
14	6S	4W	11	SW 1/4	80	Silt stone & SS
15	7S	7W	23	NW 1/4, NW 1/4	200	Calc. Sand
16	7S	7W	24	NE 1/4, NE 1/4	165	SS + Sh Residuum
17	7S	6W	30	SE 1/4, SE 1/4	180	SS + Sh Residuum
18	7S	6W	34	SE 1/4, SE 1/4	180	SS Residuum
19	8S	6W	7	NE 1/4, NE 1/4	200	SS Residuum

APPENDIX B

The soil test data tabulated below was obtained from consultants' reports prepared for the Indiana State Highway Commission. The location of the site is shown on the attached engineering soils map. Considerable additional data is contained in the consultants reports.

Site	Station	Offset (ft.)	Depth (ft.)	AASHTO Classification	Texture	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	L.L.	P.L.	P.I.	S.L.
1	1026+00"A"	42 Rt	1-2	A-4(8)	Si.Cl.L	5	11	57	27	28	22	6	23
2	1033+00"A"	42 Rt	8.5-10	A-6(8)	Clay(Shale)	2	13	39	46	37	26	11	23
3	1038+00"A"	42 Rt	3-6	A-4(8)	Si.Cl.	1	7	54	38	31	23	8	19
4	1080+00"A"	42 Rt	4.5-6	A-7-6(18)	Clay	1	8	36	55	52	21	31	18
	1080+00"A"	42 Rt	12-12.4	A-6(0)	Clay(partly cemented)	4	15	46	35	32	18	14	16
5	1099+80"AL"	42 Lt	0.5-4	A-7-6(10)	Si.Cl.L	0	4	72	24	42	27	15	25
6	1106+00"AL"	70 Lt	11-15	A-7-6(11)	Clay(Shaly)	1	5	41	53	43	26	17	21
7	1112+50"A"	42 Rt	2.5-4	A-7-6(15)	Clay	2	11	36	51	51	28	23	24
	1112+50"A"	42 Rt	8-12	A-7-6(16)	Clay(Shaly)	0	23	24	53	52	28	24	27
8	1129+00"AL"	42 Lt	5-6	A-4(8)	Clay(partly cemented)	1	34	32	33	24	17	7	19
9	1133+00"A"	42 Rt	7-8	A-7-6(18)	Clay	0	33	15	52	52	17	35	13
10	1167+50"A"	70 Rt	4.5-7.5	A-7-6(20)	Clay	5	9	29	57	63	25	38	17
	1167+50"A"	70 Rt	7.5-10	A-7-6(12)	Clay	2	8	34	56	45	27	18	22
11	1180+00"A"	70 Rt	8-9.5	A-7-6(13)	Clay(Shaly)	0	2	44	54	45	26	19	25
12	1217+00"A"	42 Rt	12.5-14	A-6(8)	Si.Cl.L	0	16	56	28	30	19	11	19
13	1231+60"A"	42 Rt	6-8	A-6(10)	Clay	3	24	42	31	36	21	15	17
	1231+60"A"	42 Rt	13.5-17	A-7-5(13)	Clay	2	28	22	48	53	36	17	23
	1231+60"A"	42 Rt	17-18	A-6(13)	Clay	2	9	30	59	37	14	23	17
14	1387+00"A"	42 Rt	1-4.0	A-4(5)	Clay Loam	9	39	30	22	27	18	9	19

Site	Station	Offset (ft.)	Depth (ft.)	AASHTO Classification	Texture	Percent Gravel	Percent Sand	Percent Silt	Percent Clay	L.L.	P.L.	P.I.	S.L.
15	1392+00"AL"	70 Lt	5-7	A-7-5(18)	Clay	1	17	30	52	58	33	25	15
	1392+00"AL	70 Lt	7.5-9.0	A-6(9)	Clay(Shaly)	2	19	29	50	36	24	12	18
16	1434+40"A"	42 Rt	0.5-2.0	A-6(8)	Silty Clay	2	14	54	30	35	24	11	24
17	1438+00"AL"	70 Lt	0.5-2.0	A-7-6(11)	Silty Clay	7	14	49	30	44	29	15	16
	1438+00"AL"	70 Lt	5.0-6.0	A-7-6(18)	Clay(Shaly)	1	21	40	38	54	25	29	19
18	1467+60"AL	42 Rt	5.0-7.0	A-6(9)	Clay w/ Shale Frag.	7	20	33	40	40	28	12	21
19	1471_50"AL"	70 Lt	10.0-10.5	A-4(3)	Sa.Cl.L(or soft sandstone)	9	53	18	20	23	16	7	17

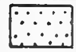
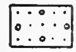
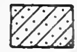
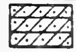
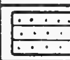
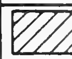
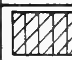
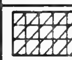
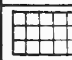
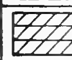
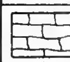
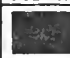
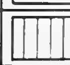
APPENDIX C

The soil test data tabulated below was obtained from the "Report of Roadway Soil Survey ST-Project No. 0753A P.E. SR 45 North of Chrisney in Spencer County, Indiana", by the Indiana State Highway Commission, Division of Materials and Tests, Soil Department.

Site	Station	Offset (ft.)	Depth (ft.)	AASHTO Classification	Texture	Percent				L.L.	P.L.	P.I.
						Gravel	Sand	Silt	Clay			
20	97+54	36 Lt	1.0-2.5	A-6(12)	Si.Cl.	.8	2.8	64.5	31.9	35.5	23.6	11.9
			11.0-12.0	A-7-6(13)	Clay	0	15.8	30.5	53.7	41.6	27.3	14.3
21	116+90	44 Lt	2.0-5.0	A-6(10)	Si.Cl.	1.3	13.4	53.2	32.1	36.2	24.8	11.4
			6.0-7.5	A-4(8)	Si.Cl	0	15.9	53.1	31.0	34.4	25.3	9.1
			21.0-21.6	A-6(8)	Clay	0	0.8	48.6	50.6	39.1	22.4	16.7

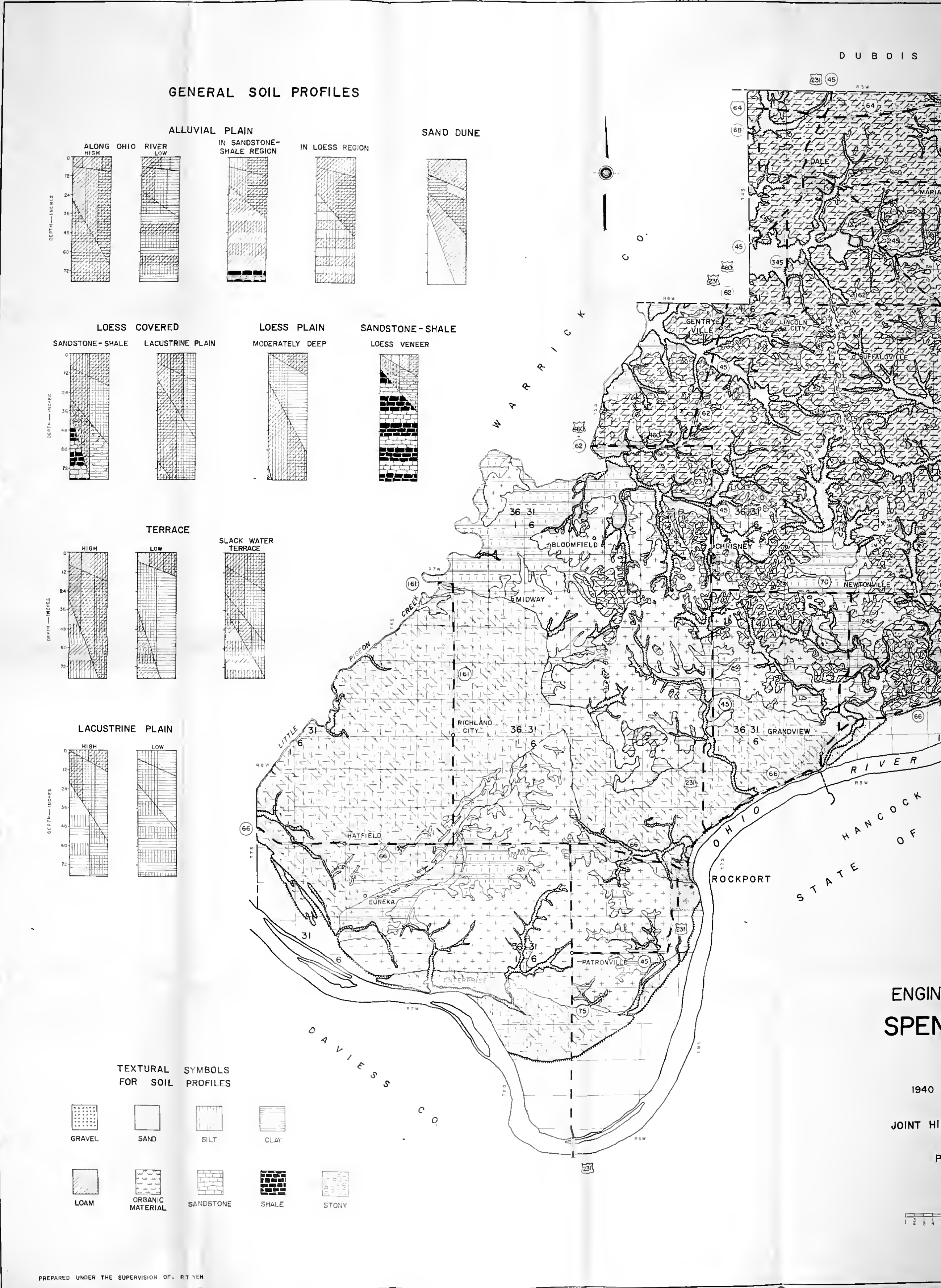
APPENDIX D

SOIL CLASSIFICATION AND PROFILE SYMBOLS

Description	Grain Size Distribution				Plastic Index	Symbol
	Gravel % Retained on #10	Sand #10–#200	Silt 0.05–0.005mm	Clay Less than 0.005mm		
Gravel	85–100	0–15	0–10	0–10	NP	
Sandy Gravel	50–85	15–50	0–10	0–10	6 Max.	
Sand	0–15	85–100	0–10	0–10	NP	
Gravelly Sand	20–49	45–85	0–10	0–10	6 Max.	
Sandy Loam	0–19	50–80	0–50	0–20	6 Max.	
Sandy Clay Loam	0–19	50–80	0–30	20–30	10 Max.	
Sandy Clay	0–19	55–70	0–15	30–45	11 Min.	
Loam	0–19	30–50	30–50	0–20	10 Max.	
Silt Loam	0–19	0–50	50–100	0–20	10 Max.	
Silty Clay Loam	0–19	0–30	70–100	20–30	11 Min.	
Silty Clay	0–19	0–15	55–70	30–45	11 Min.	
Clay Loam	0–19	20–50	50–80	20–30	11 Min.	
Clay	0–19	0–55	0–55	30–100	11 Min.	
Peat or Muck						
Limestone						
Sandstone						
Shale						
Stony Fragments						
Organic Matter						
Topsoil						

Classification of Gravelly Soils

85%–100% gravel plus finer material – Gravel
50%–84% gravel plus finer material – Clayey, silty or sandy gravel
20%–49% gravel plus finer material – Use fine classification and called gravelly sand, gravelly silt or gravelly clay
0%–19% gravel plus finer material – Use fine classification only


JHRP 78/22
GENERAL SOIL PROFILES
ALLUVIAL PLAIN
ALONG OHIO RIVER
HIGH
LOW
IN SANDSTONE-SHALE REGION
IN LOESS REGION
SAND DUNE
DEPTH — INCHES
LOESS COVERED
SANDSTONE-SHALE
LACUSTRINE PLAIN
LOESS PLAIN
MODERATELY DEEP
SANDSTONE-SHALE
LOESS VENEER
TERRACE
HIGH
LOW
SLACK WATER TERRACE
LACUSTRINE PLAIN
HIGH
LOW
TEXTURAL SYMBOLS FOR SOIL PROFILES
GRAVEL
SAND
SILT
CLAY
LOAM
ORGANIC MATERIAL
SANDSTONE
SHALE
STONY
DUBOIS
WARRICK CO.
DAVIESS CO.
STATE OF HANCOCK
OHIO RIVER
PIGEON CREEK
LITTLE
DALE
MARIA
GENTRYVILLE
LINCOLN CITY
BUFFALOVILLE
BLOOMFIELD
CHRISNEY
NEWTONVILLE
MIDWAY
RICHLAND CITY
GRANDVIEW
HATFIELD
ROCKPORT
EUREKA
PATRONVILLE
ENTERPRISE
ENGIN
SPEN
1940
JOINT HI
P
PREPARED UNDER THE SUPERVISION OF: P.T. YEH

ENGINEERING SOILS MAP
SPENCER COUNTY
INDIANA

PREPARED FROM
1940 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT.
AT
PURDUE UNIVERSITY
1978

SCALE OF MILES
0 1 2 3 4

LEGEND

PARENT MATERIAL
(GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- MODERATELY DEEP LOESS PLAIN
- LOESS COVERED LACUSTRINE PLAIN
- LOESS COVERED SANDSTONE-SHALE
- INTERBEDDED SANDSTONE-SHALE WITH LOESS VENEER
- TERRACE
- LACUSTRINE PLAIN
- SLACK WATER TERRACE
- ALLUVIAL PLAIN
- SAND DUNE

MISCELLANEOUS

- BORING SITE
- LAKE OR POND
- STRIP MINE
- SAND PIT

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

TEXTURAL SYMBOLS FOR DUNE AND TERRACE ALONG OHIO RIVER

- TERRACE ALONG OHIO RIVER
- SLACK WATER TERRACE
- LACUSTRINE PLAIN
- SAND DUNE

DRAWN BY D KILGORE

COVER DESIGN BY ALDO GIORGINI